

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of)	
)	
Unlicensed Operation in the TV)	ET Docket No. 04-186
Broadcast Bands)	
)	

To: The Commission

Comments of the Society of Broadcast Engineers, Inc.

The Society of Broadcast Engineers, Incorporated (SBE), the national association of broadcast engineers and technical communications professionals, with more than 5,000 members world wide, hereby respectfully submits its comments in the above-captioned notice of proposed rulemaking relating to higher power unlicensed Part 15 operation on "unused" TV Broadcast channels.

I. Proposal Would Inevitably Result in Interference to Licensed Services

1. The Commission proposes to allow expanded use of higher power unlicensed Part 15 devices on unused TV broadcast channels.¹ SBE must point out that in the large metro areas of the United States, there are for all intents and purposes no "unused" TV channels. SBE bases this conclusion on the use of conventional F(50,50) and F(50,90) protected contours for licensed stations, as proposed in Paragraph 29 of the Notice of Proposed Rulemaking (NRPM). Even outside of the major metro areas there are few TV channels that can be used without impinging on other authorized spectrum users and uses. If these few "unused" TV channels could be reliably detected, based upon both location and time, SBE would have no objection to this proposal. But, as will be documented in this filing, it is unrealistic to expect reasonably priced higher power Part 15 devices to be able to do so. The result would be increased interference to licensed services, particularly to Part 74 broadcast auxiliary service (BAS) stations that operate on TV channels. For this reason SBE urges the Commission to not adopt the proposed rules.

¹ SBE notes that Section 15.209 of the FCC Rules already allows Part 15 operations on TV channels, although subject to very strict field strength limits. For example, for VHF TV channels the field strength may not exceed 150 μ Volts/meter (43.5 dBu) at 3 meters from the Part 15 device, and on UHF TV channels (except TV Channel 37, where no Part 15 operation is permitted), the field strength may not exceed 200 μ Volts/meter (46.0 dBu) at 3 meters.

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2. While the NPRM focuses on protecting full-service NTSC analog and digital TV stations, this is not the entire universe of licensed stations that are entitled to protection from Part 15 operations. There are also:

Part 73 Class A TV stations

Part 74, Subpart F, point-to-point TV BAS links that operate on UHF TV channels

Part 74, Subpart G, Low Power TV (LPTV) stations

TV translator stations

TV booster stations

and, far most problematic,

Part 74, Subpart H, Low Power Auxiliary stations.

While Part 74 BAS stations are secondary to the operations of Part 73 full-service TV and DTV stations, they are **not** secondary to, or even co-equal with, Part 15 devices. As licensed stations, Part 74 BAS operations are afforded interference protection from Part 15 devices.²

3. SBE concedes that a "smart" high power Part 15 device could theoretically be designed to protect full-service TV, DTV, Class A TV, TV translator, TV booster, and fixed link TV BAS stations because such stations are at known, fixed sites, and typically transmit continuously. Protecting not-always-transmitting, mobile/portable/itinerant BAS Low Power Auxiliary stations such as wireless microphones and wireless video assist devices (WAVDs) is a much taller order. So much so that SBE does not believe that any high power Part 15 device or system attempting to use the now reduced number of "unused" TV channels could ever do so in a reliable manner. Indeed, high power Part 15 devices truly meeting their mandate to not cause interference to licensed services would likely be so unreliable they would be practically un-useable.

4. The NPRM appears to recognize the difficulty in protecting non-fixed site receivers by proposing that TV Channels 14–20 not be available for high power Part 15 use in markets where these channels have been reallocated for private land mobile radio service (PLMRS) and commercial mobile radio service (CMRS) use (NPRM, at Paragraph 33). But this very same problem of how to protect the receivers of mobile/itinerant/portable PLMRS/CMRS stations also applies to Subpart H Part 74 Low Power Auxiliary stations, but with the problem

² See Section 15.5(b) of the FCC Rules.

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augmented by the fact that these stations are not restricted to just certain large metro areas, and can use a much wider range of TV channels. The Commission cannot logically conclude that high power Part 15 devices must be banned from TV Channels 14–20 in markets where those channels have been re-allocated to land mobile services, but not be banned from TV Channels 7–13, 14–36, and 38–51 in those areas where Subpart H Low Power Auxiliary stations are licensed to operate. Then there is the threat that the end users of high power Part 15 devices would import those devices into areas which have Part 90 "T band" operations, both knowingly and by accident. This could only be avoided by a GPS lockout built into the device. But, as is discussed in the following paragraph, this is unlikely to be a workable solution.

5. SBE believes that global positioning system (GPS) receivers integrally installed in a high power Part 15 device could indeed let the device know its location, compare it to a data base of known fixed site licensed stations, and not permit transmission if within a specified preclusion zone³. However, this would likely raise the cost of the high power Part 15 device so as to make it unaffordable. Even if embedded GPS receivers in high power Part 15 devices were inexpensive, high power Part 15 devices would need to have an effective GPS antenna in order to determine their location. This could be problematic for a high power Part 15 device in a "shielded" high-rise office building, sports venue, convention center, or in an "urban canyon" or other location with little or no line of sight to GPS satellites.

6. Even if "smart" high power Part 15 devices were cost-effective, there would still be the challenge of keeping licensed user databases inside high power Part 15 devices up to date once the high power Part 15 devices have been distributed to end users. There is also the predictable reality that end users will sooner or later "hack" or otherwise defeat protocols designed to reduce (not eliminate) interference to licensed or otherwise protected users.

7. The NPRM completely overlooks that Section 74.24 of the Part 74 Rules allows operation of BAS links from temporary sites for up to 720 hours per year. Thus, a Part 74 STL or TSL operating on a UHF TV channel could be legally operating on a temporary new path, and there would be no way for a high power Part 15 device equipped with a lock-out GPS receiver to know the new location of the link's receive end. Yet even a Part 74 station operating pursuant to

³ Paragraph 29 of the NPRM proposes various protected contours for various classes of TV, Class A, LPTV, TV Translator and DTV stations. Just how a high power Part 15 device would calculate the protected contours of some 1,700 TV stations, 600 Class A TV stations, 1,700 DTV stations, 2,100 LPTV stations and 4,700 TV translator stations is a great mystery to SBE. And, since these stations can modify their transmitting facilities, their protected contours would also change. SBE believes that it will be impossible for an in-the-field high power Part 15 device to keep track of well over 10,000 protected contours, to say nothing of monitoring changes to these stations.

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Section 74.24 of the FCC Rules is entitled to protection from interference from an un-licensed high power Part 15 device. The same threat would apply to special temporary authority (STA) operation of a BAS station on a TV channel: There would be no mechanism to let the database inside a high power Part 15 device know of the existence of STA operations on TV channels.

8. SBE also concedes that high power Part 15 devices could be built with "polite protocols" that depend on an embedded scanning receiver that would detect the presence of an existing signal on a TV channel, and would again preclude the high power Part 15 device from transmitting on that frequency.⁴ However, the embedded scanning receiver would need to be able to recognize a wide variety of protected transmissions, from narrow band signals from a wireless microphone, to a 6-MHz wide video signal. That then raises the issue of the step size or increment that an imbedded scanning receiver would need to use to ensure it did not miss a licensed FM wireless microphone signal. Some FM wireless microphones use steps of as small as 25 kHz, and the smaller the "steps" of a scanning receiver, the longer it will take to scan a 6-MHz wide TV channel. SBE therefore suspects that an embedded scanning receiver design would not be cost-effective either. SBE must point out that a "listen-before-transmit" protocol doesn't always work if the protected station is not continuously transmitting, and Subpart H Low Power Auxiliary stations typically do not transmit continuously. Further, in the event of weak signal areas for a protected station, high power Part 15 devices may not detect even a continuous duty protected signal, and as a result could inappropriately transmit and block licensed users employing more sensitive external receiving antennas from receiving a transmission from a licensed, and thereby protected, transmitter.

9. SBE also sees serious flaws with a high power Part 15 device designed to operate continuously on an "unused" TV channel, such as a wireless local area network (WLAN). A continuously operating device can, of course, only listen *before* it starts transmitting. Once the high power Part 15 device commences continuous operation on any given TV channel it would never check for any licensed operations which may start or resume, thus precluding or interfering with the reception of signals from licensed stations. In dense urban areas, a single high power Part 15 device could wipe out reception of a licensed TV station to a whole apartment complex if the high power Part 15 transmitter is close to a master antenna receiving system. It is also not hard for SBE to envision a seemingly limitless number of "always on" high power Part 15

⁴ This harkens back to an old provision within the Part 74 rules applying to Subpart D remote pickup (RPU) stations, that used to require "lock out" receivers for repeaters. The Commission wisely deleted this rule after the broadcast engineering community questioned the credibility, effectiveness and added cost of "lock out" receivers.

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WLANs, video security cameras, and other video links ("see your DVD in the other room"), causing a corresponding seemingly limitless amount of interference to licensed services using those very same and supposedly "unused" TV channels. For example, there are now ads for a "wireless flat panel TV" that uses unlicensed, Part 15, 802.11b 2.4 GHz technology to connect the LCD screen to its base, which contains the device's larger electronic modules.⁵ SBE believes that if such products are available for 2.4 GHz high power Part 15 devices, it wouldn't be long before they proliferated to supposed "unused" TV channels, should the Commission imprudently authorize such use.

10. Yet another fundamental limitation of polite protocol, listen-before-transmit devices is that they cannot "hear" or otherwise detect receivers affiliated with licensed stations. This limitation would impact several classes of licensed users, especially Part 74 Subpart H TV BAS links. In the case of TV studio-to-transmitter (STL) and inter city relay (ICR) links, the licensed transmitter may be far enough from the high power Part 15 device that it cannot detect the signal of the licensed station that it is obligated to protect. Consequently the high power Part 15 device would conclude that the channel is "unused" and start transmitting, thus causing harmful interference to the receiver of a licensed station.

11. This inherent receiver blindness of polite protocol devices would have the potential to cause interference to viewers in rural areas attempting to receive service from distant full power TV and DTV stations, or from low power TV translator and LPTV stations. Viewers in such areas must often employ "heroic" reception efforts such as the installation of high-gain receiving antennas with mast-mounted preamplifiers, in order to obtain a useable signal from a distant full power station or from a nearby TV translator or LPTV station. A high power Part 15 device with a grudgingly-installed, FCC-mandated, monitoring receiver employing a low gain receiving antenna could again conclude that a particular TV channel was "unused" and commence transmitting, only to interfere with the reception of a neighbor's TV viewing.⁶

12. SBE must also ask how would high power Part 15 devices distinguish between a new transmission from a protected, licensed station versus another high power Part 15 device? The only answer SBE can think of would be to require high power Part 15 devices to transmit a "Part 15 flag" announcing their bottom-of-the-RF food chain status. But such a requirement would create a strong incentive on the part of the high power Part 15 manufacturer and the high power

⁵ See, for example, <http://www.sharppusa.com/products/ModelLanding/0,1058,1258,00.html>.

⁶ SBE has to remind the Commission that a high power Part 15 device might not have any properly connected monitoring antenna (by accident, of course). This was one of the common problems found in the field with the now discontinued Part 74 "lock out" receivers previously mentioned.

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Part 15 users to be widely ignored or defeated. Manufacturers may figure that the Commission would only be able to catch a minute portion of non-complying high power Part 15 devices, and/or end-users will find the inevitable "how to defeat" instructions on the Internet.

II. DTV Stations Would Be Particularly At Risk

13. Even if "smart" high power Part 15 devices could be built, and kept updated to changes in the protected contours of licensed stations, DTV stations would still be very much at risk of harmful interference. This is for two reasons: DTV threshold levels are 19 to 23 dB weaker than the equivalent matching NTSC thresholds, as follows:

VHF low band: 47 dBu for analog vs. 28 dBu (a mere 25.1 μ Volts/meter!) for digital

VHF high band: 56 dBu for analog vs. 36 dBu for digital at VHF high band

UHF: 64 dBu for analog vs. 41 dBu for digital at UHF.

Although 7.1 dB of this difference can be accounted for because analog is F(50,50) whereas digital is F(50,90), there is no question that a DTV tuner must navigate through a much more hostile and challenging RF environment. The second reason why DTV signals would be more at risk from high power Part 15 devices operating on "unused" TV channels is that for a digital receiver the display for all problems appears as blue-screen squelch. So, unlike a degraded analog signal, where the nature of the degradation gives the technically astute viewer much information about what the problem is, a squelched digital receiver divulges no information about what the problem might be. This makes DTV reception far more at risk than analog reception to interference from co-channel and nearby high power Part 15 devices. If the Commission wants to encourage the early purchase of DTV receivers and set-top boxes by America's viewing public, the last thing it should be doing is planting high power Part 15 "land mines" into the DTV landscape. It is for this reason, if no other, that at the very least allowing high power Part 15 devices on unused TV channels should be postponed until after the end of the DTV transition period (and even better, not allowed ever).

14. Then there is the reality that the 2006 end of the transition period is approaching. Out-of-core DTV stations on TV Channels 52–69 will be searching for in-core frequencies on TV Channels 2–51. This is not the time to be hindering or sabotaging the process by allowing an impossible-to-take back contamination of in-core TV channels by high power Part 15 devices that may or may not respect their Part 15 status.

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III. FM Wireless Microphone Model in the NPRM is Flawed

15. At paragraph 38 of the NPRM, the Commission concludes that licensed FM wireless microphones operating on TV channels would not be at risk of interference from high power Part 15 devices also operating on TV channels because the operating range of licensed FM wireless microphones would be "hundreds of feet at the most." This assumption is flawed for at least two reasons: First, many productions frequently employ long-distance telephoto shots that rely on wireless microphones to capture useable dialog. The received FM wireless microphone signal level is weak under such conditions and would be especially prone to interference from co-channel high power Part 15 devices. Even for the RF-isolated theatrical and sport venues assumed by the Commission, there is no guarantee that high power Part 15 devices operating on "unused" TV channels would not be inadvertently used in those same venues, causing show-stopping interference to broadcasts and/or performances. Hourly costs for such events are measured in the thousand, or tens of thousands of dollars. Shutting down productions while interference tracking and mitigation takes place is a costly but necessary process if the show must go on. For live shows, though, there may be no reasonable work-around. SBE believes that, pursuant to the Commission's June 24, 2004, public notice (discussed in more detail in a subsequent paragraph), it would appear that the operators of such venues would be powerless to restrict such high power Part 15 operation.

**IV. Existing High Power Part 15 Devices Are
Already Causing Chronic Interference to Licensed Users**

16. High power Part 15 WLANs, aka IEEE 802.11b spread spectrum devices, operate between 2,400–2,483.5 MHz, with transmitter powers (TPOs) of up to 1 watt (30 dBm) and equivalent isotropic radiated powers (EIRPs) of up to 4 watts (36 dBm).⁷ These devices already cause chronic interference to licensed operations on TV BAS Channels A8 (2,450–2,467 MHz) and A9 (2,467–2,483.5 MHz). Enforcement efforts to quell the epidemic interference from existing Part 15 devices has been lacking, as far as SBE can tell. See, for example, the recent SBE comments and reply comments to ET Docket 03-108 regarding "cognitive" or "smart" radios. Then there is the difficulty of *finding* an offending high power Part 15 device, to say nothing of persuading the operator of that device to shut it down. Broadcasters know this problem all too well as a result of chronic interference to TV BAS Channels A8 and A9 from high power Part 15 spread

⁷ Another pending OET rulemaking, ET Docket 03-108, proposes further increasing the allowable power for 2.4 MHz Part 15 wireless LAN devices to 6 watts (37.8 dBm) TPO and 24 watts (43.8 dBm) EIRP, and also proposes opening up 2,483.5–2,500 MHz to such super high power Part 15 operations.

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spectrum devices operating between 2,400–2,483.5 MHz, where they generate co-channel interfering signals.

17. This then raises the issue of just what higher power level the Commission believes would be acceptable? Based on free space, the allowable EIRP for a transmitter to not exceed 150 $\mu\text{V/m}$ at 3 meters is just 0.0067 μWatts , and the allowable EIRP for a transmitter not to exceed 200 $\mu\text{V/m}$ at 3 meters is just .0119 μWatts . Thus, allowing high power Part 15 devices on "unused" TV channels with an EIRP of just 1 mW (1,000 μWatts , or 0 dBm) would represent increasing the interference threat from Part 15 operations by a mind-boggling 51.7 dB at VHF and 49.2 dB at UHF! Surely engineering common sense should tell the Commission that a 50 dB increase in the interference threat from Part 15 operations would not be a prudent undertaking, and would be especially ill conceived given the on-going rollout of DTV services.

**V. There Is No Such Thing as a "Frequency Coordinated"
High Power Part 15 Device!**

18. At Paragraph 41, discussing compliance and enforcement, the concept of requiring high power Part 15 users to register their equipment with private party (*i.e.*, not FCC) "frequency coordinators" is raised. SBE believes that such an approach would be completely unworkable, impractical, and impossible to enforce. The NPRM goes on to ask if parties providing information about high power Part 15 devices operating on supposedly "unused" TV channels should be held "responsible" for the validity of that information. This presumes that control over a high power Part 15 device can be maintained once the device has been sold to a customer. This is nonsense, and dangerous nonsense, at that. Once a high power Part 15 device has been sold neither the seller nor the Commission has any control over when, where or how that device will be used. Only if the high power Part 15 device itself has realistic and practical safeguards against interference to licensed services built into it is there any reasonable expectation that interference will not be caused.

19. Further, SBE believes that many, perhaps most, vendors of high power Part 15 devices could care less about the interference potential of such devices. They are primarily interested in making the sale. Sales of such high power Part 15 devices over the Internet would be particularly prone to inappropriate use. And even vendors that might have honest concerns about interference to licensed services would be powerless to control when, where and how the purchaser operates the device.

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20. SBE believes that many users are typically unaware of a device's FCC status (*i.e.*, licensed vs. unlicensed) unless they are told by a vendor. Additionally, most users only look at the manual when the product doesn't work-- and they hardly ever read the "legalese fine print"-- which is usually where the licensing status information is "hidden." And, by this time, they already *own* the product! This is evidenced by all the Part 74 (license required) wireless devices being used outside the FCC's rules in nuclear power plants (Telex Intercoms), churches and auditoriums, including possibly the FCC's own conference room in Washington, DC. Users simply rely on the word of the vendor that "you don't need a license to use this device," purchase the device and assume that it will work. When it doesn't, or stops working due to interference, the user returns it as "broken," or just accepts the loss. The vendor, on the other hand, has a built in conflict of interest: If he tells the user they legally can't use the device without FCC authorization, the vendor could lose the sale. So everyone "assumes" the user is aware of the product's license status and sells them a product that they may not actually be able to license, furthering the "wink and a nod" marketing that is so common for devices requiring an FCC license.

21. Ultimately, it's the user that is stuck with a device that simply quits working when a new station goes on the air; just like all those hospitals found out when the first VHF DTV station commenced operation. The FCC would be setting up a whole new class of users for failure, with broadcasters becoming the "bad guy" when the devices fail, even though high power Part 15 operations were never entitled to interference protection in the first place.⁸

VI. If TV Channels 2–4 Must Be Precluded, Then All TV Channels Must Be Precluded!

22. The NPRM proposes that TV Channels 2–4 be precluded to ensure that interference to TV receivers connected to cable set top boxes, video cassette recorders, DVD players, video games, and other consumer electronic devices that generate an RF output on TV Channels 2, 3 or 4, do not receive interference from a nearby high power Part 15 device operating on one of those channels. But, if the Commission is concerned that interference to cable boxes and other consumer electronics that output on TV Channels 2, 3 or 4 might be caused by a nearby high power Part 15 device, then the Commission must logically extend that prohibition to all VHF TV channels, and to TV Channels 14 to 51 (470–698 MHz), because these frequencies can be (and

⁸ As a classic and recent example that lay users of Part 15 devices simply don't understand that Part 15 devices are not protected from interference, see http://www.f-16.net/f-16_forum_viewtopic-t-1064.html, "Air force Radios Jam Garage Door Openers."

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are) used by cable-ready TV receivers. Of course, in this event all of the "vacant" TV channels will have been precluded, and this rulemaking is moot.

**VII. Wideband and Narrowband High Power Part 15 Applications
Would Be Incompatible**

23. The NPRM appears to encourage wideband high power Part 15 applications (*i.e.*, transmissions occupying an entire 6 MHz wide TV channel) as well as narrowband high power Part 15 applications. This strikes SBE as a fundamentally incompatible sharing of spectrum between high power Part 15 devices. In effect, it would be the "kiss of death" to narrowband users operating on "unused" TV channels, both licensed and unlicensed. A single wideband high power Part 15 device in use at an event like the Super Bowl or a political convention could easily put out of commission thirty or more wireless microphones, assuming that the wireless microphones are spaced 200 kHz apart and occupying that same 6 MHz TV channel. At some events, wireless microphones have been spaced even closer than 200 kHz, which becomes practical when there is space or time diversity between users. At a recent Super Bowl, interference was caused to multiple wireless microphone channels when an improperly coordinated WAVD device occupying an entire 6 MHz TV channel was used: The majority of the half-time entertainment wireless microphones and interruptible fold back (IFB) communications were lost. Luckily, it was during a rehearsal, and not game day.

24. Accordingly, if both wideband and narrowband high power Part 15 devices are to be allowed, the Commission needs to designate some "unused" TV channels for wideband only operations, and other "unused" TV channels for narrowband only operations. Of course, the best solution would be to not allow the contamination of TV channels by high power Part 15 devices in the first place.

**VIII. If High Power Part 15 Devices Are Authorized on "Unused" TV Channels,
Stringent and Rigorous Safeguards Must Be In Place to Ensure That These Devices
Are Not "Hacked"**

25. In the August 6, 2004, R&O to WT Docket 02-55 (800 MHz SMR Interference), the Commission states in more than one instance (as early as Paragraph 2, for example) that the need for such a substantial overhaul of the 800 MHz band arose from "a fundamentally incompatible mix of two types of communications systems." If that is true of high-site and cellular two-way systems in the same band, how much more true must that be of TV broadcasting (single, high-site transmitter to multiple receivers) and the proposed high power Part 15 wireless devices (multiple

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transmitter/receiver devices distributed over a wide, but unknown, area)? SBE urges the Commission not to repeat the mistake that was made in the 800 MHz band by allowing the TV broadcast bands to be irretrievably contaminated by high power Part 15 devices.

26. If the Commission nevertheless decides to allow high power Part 15 devices on "unused" TV channels, there must be strict and rigorous manufacturing requirements to ensure that the protocols and safeguards built into those devices, to reduce the likelihood of interference to licensed users, cannot be easily defeated. Techniques such as tamper-resistant cases and epoxied circuit boards that self-destruct if unauthorized modifications are attempted, should be mandatory. The Commission should also step up its Part 15 enforcement efforts; or, better still, not prohibit state or local governments from enforcing the Part 15 rule of no interference to licensed services.

27. For example, SBE notes that on June 24, 2004, the Office of Engineering and Technology (OET) issued a public notice *Commission Staff Clarifies Role Regarding Radio Interference Matters and Its Rules Governing Customer Antennas and Other Unlicensed Equipment*.⁹ That notice pointed out that only the FCC has jurisdiction "involving radio frequency interference (RFI) when unlicensed devices are being used, regardless of venue." If the Commission is going to insist that the only parties who can investigate and resolve interference from Part 15 devices to licensed users are the pathetically small number of FCC inspectors, then the Commission owes it to its licensees not to be naive in expanding the number and types of Part 15 devices that can be operated.

IX. Summary

28. SBE urges the FCC not to further open the Part 15 "Pandora's Box," and instead to apply a good dose of engineering common sense and not adopt this ill-conceived proposal. SBE believes that the action contemplated by the Commission is premature and conflicting with other agenda items such as DTV channel packing, refarming of spectrum, and has no immediate benefit to the public that is not already being served in other services. But, if high power Part 15 devices on "unused" TV channels are nevertheless to be authorized, then:

28a. Such operation should not be allowed until after the DTV transition is complete.

28b. Wideband and narrowband high power Part 15 devices should not attempt to share the same TV channel.

⁹ DA 04-1844, released June 24, 2004.

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- 28c. The Commission must require the manufacturers of such devices to follow strict and rigorous protocols to ensure such devices cannot be "hacked."
- 28d. The Commission should closely monitor the manufacturers and vendors of such devices for compliance with interference-protection protocols and for anti-modification tamper resistance.

Respectfully submitted,

Society of Broadcast Engineers, Inc.

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